

**CLAIMS**

**What is claimed is:**

- 5           1.     A system for automating review of capture verification by a  
medical practitioner, the system being configured for use with an  
implantable stimulation device implanted in a patient and a programmer  
operated by the medical practitioner and configured to remotely  
communicate with the implantable stimulation device, the system  
10 comprising:  
autocapture means for performing automatic capture verification  
through the implantable stimulation device to detect a presence  
of a captured cardiac event and an absence of a captured  
cardiac event when the captured cardiac event is expected;  
15 control means for generating a visual representation of the  
presence and absence of the captured cardiac event; and  
display means for displaying the visual representation to the  
medical practitioner, to permit the medical practitioner to  
examine and analyze the performance of the automatic capture  
20 verification.
2.     The system of claim 1, further comprising:  
first selection means, operatively coupled to the autocapture  
means, for selecting one of an atrial and a ventricular chamber  
25 of the patient's heart at which the capture verification is  
performed.
3.     The system of claim 1, wherein:  
the autocapture means comprises a plurality of unique means for  
30 automatic capture verification; and  
the system further comprises second selection means, operatively  
coupled to the autocapture means, for selecting a particular one

of the unique automatic capture verification means for performing the automatic capture verification.

4. The system of claim 1, wherein:

5 the autocapture means further comprises means for detecting a plurality of additional cardiac events occurring during the automatic capture verification, and  
the control means further comprises means for identifying the plurality of additional cardiac events in the visual  
10 representation.

5. The system of claim 4, wherein the plural additional cardiac events comprise physiological atrial and ventricular events.

15 6. The system of claim 1, wherein the control means further comprises:  
means for identifying in the visual representation a plurality of pacing events occurring during the automatic capture verification.  
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7. The system of claim 6, wherein the plural pacing events comprise atrial and ventricular pacing pulses.

25 8. The system of claim 7, wherein:  
each of the plural pacing events comprise amplitude and duration characteristics; and  
the control system further comprises means for recording, in the visual representation, the amplitude and duration characteristics for the each pacing event of the plurality of pacing events.  
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9. The system of claim 1, wherein the control means further comprises:

means for marking the captured cardiac event in the visual representation with a visual marker representative of capture; and

means for marking absence of the captured cardiac event with a visual marker representative of absence of capture in a location in the visual representation where the captured cardiac event was expected to occur.

10. The system of claim 1, further comprising:

means for automatically assessing a pacing threshold value of the implantable stimulation device;

means for adding a suitable safety margin to the pacing threshold value to determine recommended pacing amplitude and pulse width; and

means for displaying the recommended pacing amplitude and pulse width.

11. The system of claim 10, further comprising:

third selection means operable for selectively activating the autothreshold means from the programmer.

12. The system of claim 10, wherein:

the control means further comprises means for generating an additional visual representation of the pacing threshold assessment; and

the additional visual representation is displayed to the medical practitioner on the display means, to permit the medical practitioner to examine and analyze the performance of the automatic pacing threshold assessment.

13. The system of claim 1, further comprising:  
printing means operatively coupled to the control means for  
generating a printed copy of the visual representation.

5 14. The system of claim 12, further comprising:  
printing means operatively coupled to the control means for  
generating a printed copy of the additional visual  
representation.

10 15. A system for automating review of capture verification by a  
medical practitioner, the system being configured for use with an  
implantable stimulation device implanted in a patient and a programmer  
operated by the medical practitioner and configured to remotely  
communicate with the implantable stimulation device, the system  
15 comprising:  
autocapture means for performing automatic capture verification  
through one of the implantable stimulation device or the  
programmer;  
detection means for detecting presence and absence of expected  
20 cardiac events during the automatic capture verification;  
control means for identifying a captured cardiac event when the  
captured cardiac event is detected, and for identifying, when an  
expected captured event is not detected, an absence of the  
expected captured cardiac event;  
25 marking means for marking each of the identified captured cardiac  
events and the absence of the expected captured cardiac  
events with a pre-determined corresponding visual  
representation; and  
display means for displaying the visual representation to the  
30 medical practitioner to permit the medical practitioner to  
examine and analyze the performance of the automatic capture  
verification.

16. A method for automating review of capture verification by a medical practitioner, the method being implemented in an implantable stimulation device implanted in a patient and a programmer operated by the medical practitioner and configured to remotely communicate with the implantable stimulation device, the method comprising the steps of:

performing an automatic capture verification through one of the implantable stimulation device or the programmer by adjusting the stimulation device's stimulation pulse energy and by detecting a presence and absence of an expected captures cardiac events;

generating a visual representation of the automatic capture verification on an output device located in the programmer, the visual representation being configured to identify a presence of the captured cardiac events when the captured cardiac event is detected, and to identify an absence of the expected captured cardiac event when the cardiac event is not detected.

17. The method of claim 16, wherein the step of performing automatic capture verification through one of the implantable stimulation device or the programmer, further comprising the steps of:

obtaining an intracardiac electrogram through the implantable stimulation device; and

performing the automatic capture verification using the intracardiac electrogram.

18. The method of claim 16, wherein the step of performing automatic capture verification through one of the implantable stimulation device or the programmer, further comprising the steps of:

obtaining an surface electrocardiogram through the programmer;

and

performing the automatic capture verification using the surface electrocardiogram.

5 19. The method of claim 16, further comprising the steps of:  
recording, in the visual representation, the amplitude and duration  
characteristics for each pacing event.

10 20. The method of claim 19, further comprising the steps of:  
marking the captured cardiac event in the visual representation  
with a visual marker representative of capture; and  
marking the absence of the captured cardiac event with a visual  
marker representative of absence of capture in a location in the  
visual representation at which the captured cardiac event was  
expected to occur.

15 21. The method of claim 20, further comprising the step of:  
automatically assessing a pacing threshold of the implantable  
stimulation device;  
determining a recommended pulse amplitude and pulse width  
20 above the pacing threshold to ensure capture; and  
displaying the recommended pulse amplitude and pulse width on  
the programmer.

25 22. A method for automating review of capture verification by a  
medical practitioner, the method being implemented in an implantable  
stimulation device implanted in a patient and a programmer operated by  
the medical practitioner and configured to remotely communicate with the  
implantable stimulation device, the method comprising the steps of:  
30 (a) selectively initiating automatic capture verification by the  
medical practitioner;  
(b) performing automatic capture verification through the  
implantable stimulation device;

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- (c) detecting, by at least one of the implantable stimulation device and the programmer, presence of cardiac events and absence of expected cardiac events during the automatic capture verification;
- 5 (d) identifying, by at least one of the implantable stimulation device and the programmer, a captured cardiac event when the captured cardiac event is detected, and when an expected capture event is not detected, identifying an absence of the expected captured cardiac event;
- 10 (e) marking, by at least one of the implantable stimulation device and the programmer, at least one of the identified captured cardiac event and the absence of the expected captured cardiac event with a pre-determined corresponding event marker;
- 15 (f) generating, by at least one of the implantable stimulation device and the programmer, a visual representation of the identified cardiac events and the event markers; and
- (g) displaying, at the programmer, the visual representation to the medical practitioner to permit the medical practitioner to
- 20 examine and analyze the performance of the automatic capture verification.